CERAMICS

JUNE
1954

No. 64 Vol. VI

(AP)

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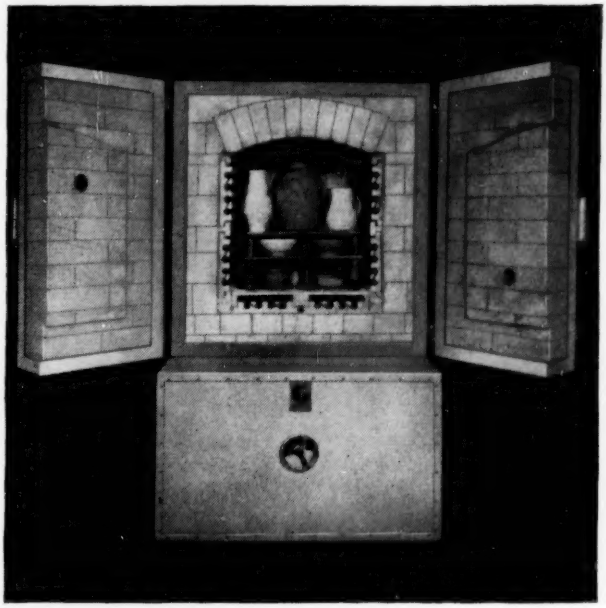

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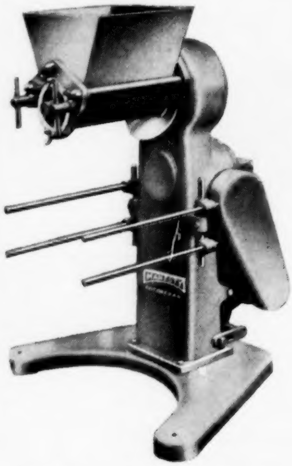

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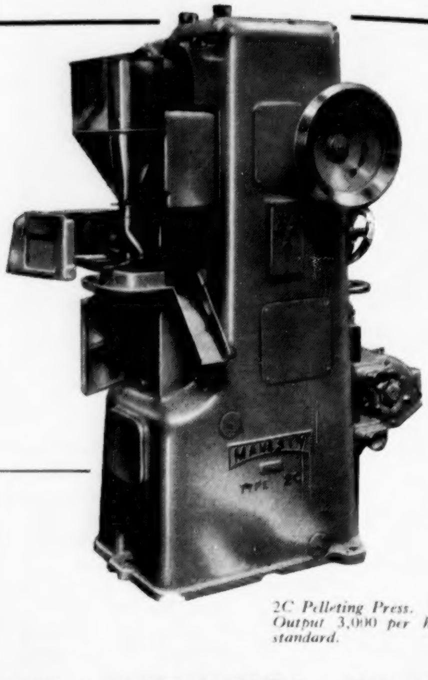

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CERAMICS

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JUNE 1954

FEATURE ARTICLES

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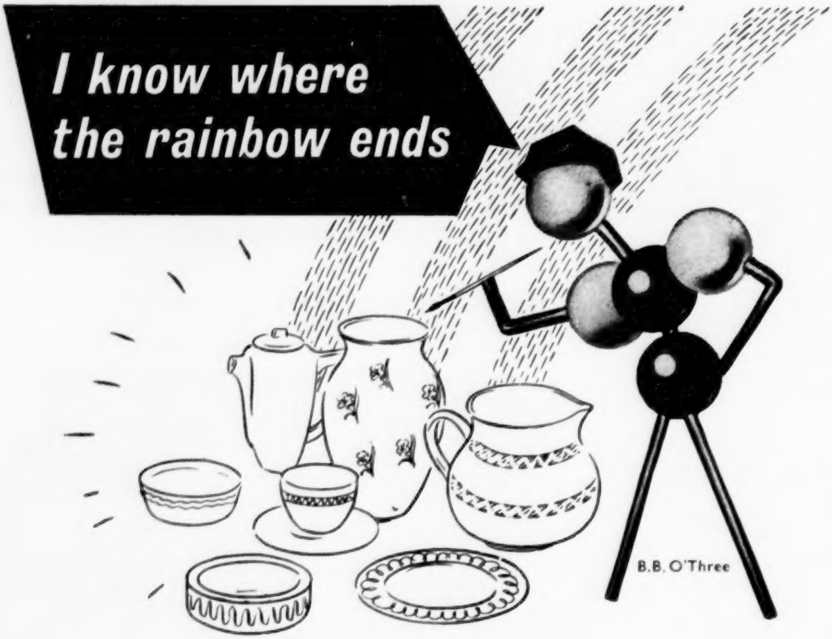

I know where
the rainbow ends
B.B. O'Three

Ceramics

VOL. VI JUNE, 1954 NO. 64

Pottery Outlook, 1954

SINCE 1951 when pottery exports were the highest ever, the industry has faced a declining overseas market: many reasons have been advanced to account for this, the chief of which has been competition from the reconstituted industries of Germany and Japan. In addition, increased costs of fuel, materials and wage increases have had to be faced. Earthenware prices correspondingly increased recently from 5 to 7½ per cent. and china pottery is expected to increase similarly next month.

There seems, however, to be no adverse effect on demand: yet competition is being faced strongly at the lower end of the trade. Japan is competing vigorously in the lower quality markets, but for the higher qualities the demand for British commodities prevails. Of course the industry has, to a large extent, been re-equipped during the past few years. More attention has been paid to factory design, layout and mechanical aids to productivity. As yet, however, no automatic aid has been found to give a quality in the decorating shops equivalent to the skill of the individual and the industry is still short of some hundreds of decorators.

Again, for the time being, it would appear that with delivery dates extended to the early months of next year a soporific atmosphere prevails. However, one cannot overlook comment recently made in the *Financial Times* that the potteries are living on the stock of goodwill prevailing from the past. This paper continues:

"With one or two exceptions the pottery firms appear to be extremely conservative in outlook."

The *Financial Times* goes on to point out that craftsmanship by itself is insufficient for the preservation of an industry. It also points out that the dominant position won by British potteries in international markets was not only due to technical excellence, but also depended upon a sense of fashion and design. The editorial comment concludes that, "In some cases—not in all—that is hardly true today."

Summarised, therefore, the position is that the pottery industry, having survived a bad war, has had several good years since. Some organisations have faced up to the future and spent many thousands of pounds in modernising their productive techniques. Others have survived and profited by the sellers' market. As has been pointed out in this column so many times, the day of reckoning for relative production costs is fast approaching, and then the cost per hundred dozen gross in terms of materials, fuel and labour will be the dominant factor in ultimate sales.

Every pottery management must know whether or not it can face this challenge with its existing equipment and process schedules.

The Determination of Grain Size and its Importance in the Ceramic Industries

(SPECIALLY CONTRIBUTED)

IN the ceramic industries we are concerned either with complete fusion as in the production of glass and glazes on enamels, or with sintering as in the production of porous materials like the earthenware body and various types of bricks. The processes involve chemical changes which may, or may not be carried to completion. Since reactions occur at the surfaces, the surface area plays an important part. The larger it is the greater chance of particles reacting together. The surface area, of course, depends on the size of the particles. It is increased by fine grinding and vice versa. Since many reactions carried out in ceramic processes are stopped when certain properties have been obtained, it is important to control the size of certain materials, otherwise variability in the product is obtained.

Grain Size of Flint Important

A good example of this is ground flint. This material enters into the composition of various pottery bodies of the earthenware type. Its purpose is to act as a refractory in the body, helping to prevent it going out of shape on firing. In addition its presence is important in making glazed bodies of the earthenware type free from crazing. This arises from the fact that silica exists in a number of mineralogical forms. These can change from one form to the other in certain temperature ranges, and the change is in some cases accompanied by expansions or contractions. In the ordinary way flint contains a form of silica called α quartz. This can change at around 550°C. to the β form with an expansion. β quartz can be changed by further heating to β cristobalite, again with an expansion. This actually happens in the biscuit firing of earthenware, when part of the quartz is changed in this way to cristobalite. On cooling the reverse change from cristobalite to quartz is very slow and for practical purposes need not be considered. The β cristobalite on cooling to around 220°C. changes to the α form with a contraction. At this stage the glaze has solidified, and the volume shrinkage in the body due to the formation of α cristobalite exerts a squeeze on the glaze, putting it into compression. This is a valuable aid in preventing crazing, which occurs when the glaze is in tension. Fired earthenware biscuit, therefore, is likely to contain both quartz and cristobalite. The expansion of the body caused by the change α—β quartz at around 550°C. may cause the body to crack if heating is done too rapidly over that range in the glost fire. Similarly too rapid cooling may also give cracking in the same range.

Again in the manufacture of silica-containing refractory bricks it is necessary to fire at a high temperature for a long time to convert all the silica to a stable form, which will not be subject to further expansions or contractions on reheating. This is necessary to avoid damage to the structure. The formation of a particular form of silica depends not only on the heating conditions, but also on the fineness of grinding. Too fine grinding may cause the reactions to go too far. In particular the cristobalite formation may be excessive, the squeeze on the glaze too great, and peeling may result. On the other hand if the flint is too coarse the cristobalite conversion may be inadequate and the glaze

may craze. Without labouring the point further it may be seen that control of the grain size of certain materials is important to the manufacturer. Flint requires careful control for the reasons given above. Glazes and enamels are also controlled since undergrinding may give a poor surface unless the firing time is lengthened to compensate and overgrinding may give crawling.

Methods of Controlling Grain Size

Grain sizes are checked by various methods, some of which are long and not suitable for routine control of grinding operations. The methods used fall into two groups,

(a) Those based on sedimentation,
(b) Those based on elutriation.

The rapid hydrometer method and the Andreasen pipette are examples of the former and the Schöne elutriation is an example of the latter type. In addition there is a rapid method based on the measurement of the turbidity of a suspension of the ground material.

Sedimentation Methods

These depend on allowing all the particles coarser than say 0·01 mm. in diameter to settle under gravity from a dispersion in water. The concentration of fine particles in the upper layer is then measured with a hydrometer or by some other suitable method such as pipetting off a sample and evaporating and weighing the residue. The time required for the coarse particles to settle can be calculated either by Schöne's empirical formula:

$$V = 104{\cdot}7\ (S-1)^{1{\cdot}57}\ D^{1{\cdot}57}$$

where $D =$ diameter of particle

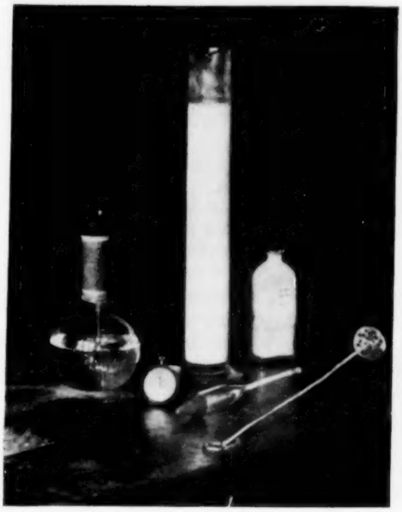
$V =$ velocity of filling in mm./sec. for a particle of 0·01 mm. in diameter.

$S =$ specific gravity of the particle.

or from Stoke's Law

$$V = \frac{2(D-d)gr^2}{9\eta}$$

Where $V =$ velocity of falling particle (cms./sec.) of radius r cms. and specific gravity D, in a liquid of



Apparatus for grain size determination by hydrometer

specific gravity d and viscosity η under the acceleration due to gravity (981 cms./sec./sec.) Stokes' Law is a more accurate way of calculating the time necessary for the coarser particles to settle, but since Schöne's formula had been widely used in the past for elutriation experiments it has been used in some of the newer ones such as the rapid hydrometer methods of Dr. H. W. Webb and Mr. S. W. Ratcliffe (*Trans. Brit. Ceram. Soc.* **41,** 51, 1942) to avoid confusion with earlier data. Where Stokes' Law is used somewhat different values are obtained. Provided the basis of calculation is known no confusion should arise.

Rapid Hydrometer Method

The disadvantage of some of the older methods of grain size determination was the length of time required. This limited their usefulness as controls for production. Webb and Ratcliffe's method enables a determination to be completed in about thirty minutes. The principle is simple. A suspension of the ground material is placed in a tall cylinder holding about a litre and sufficient time is allowed to elapse (calculated from Schöne's formula in this case) for all the particles greater than

0·01 mm. in diameter to settle out of a depth of liquid sufficient to float a hydrometer. The specific gravity of this liquid is then determined with the hydrometer and from this the weight of dry material (particles finer than 0·01 mm. in diameter) in one litre of the slip can be calculated using a variation of Brogniart's formula:

$$D = \frac{(W - 1{,}000)S}{(S - 1)}$$

where D = dry weight of the particles in one litre of slip.
W = weight of one litre of slip in grams (from the hydrometer reading).
S = specific gravity of the particles.

If R is the hydrometer reading,

$$D = \frac{(1{,}000R - 1{,}000)S}{(S - 1)}$$

$$= \frac{1{,}000\,(R - 1)S}{S - 1}$$

The weight D is then the amount of fine particles in the weight of the sample taken (usually 50 grams) and from this the percentage of particles finer than 0·01 mm. can be calculated. It is obvious that this method could also be used to evaluate the percentage of particles of other sizes present by suitable modifications. The full practical details can be obtained by reference to the original paper but the following outline may be of interest.

Standardisation of the Hydrometer

It is obvious that hydrometers vary in size and it is first necessary to find the time required for the coarser particles to sink below the centre of buoyancy of the hydrometer. The easiest way of doing this is to take a sample of ground material (50 gm. dried at 110°C.), boil it with water for thirty minutes, and then lawn through 100's and 200's lawns. The residues are washed, and the washings added to the slip passing through the lawns. The whole is then placed in a litre jar and a deflocculent added to break up lumps. (40 ml. of 2 per cent. sod. oxalate for flint; 10 ml. of the same solution for Cornish stone; 10 ml. of 4 per cent. Calgon T solution for bone). The whole is then diluted to one litre, at a temperature of 19·4°C. by adding hot and cold water.

A hydrometer, previously standardised, is placed in this after allowing it to stand for the requisite time. The reading is noted, and then the hydrometer is removed and the uncalibrated one inserted. If the reading is the same, the calibrated time is the same as that of the previous hydrometer. Usually this is not the case, and the hydrometer is removed, the liquid stirred, and allowed to settle again for a different time. The uncalibrated hydrometer is placed in it again and the reading taken. This is repeated till the reading is the same as that given by the calibrated one. The time required for this is taken as the calibration time for the new hydrometer for that particular slop material. For other slop materials the process must be repeated. Where a calibrated hydrometer is not available the powder must be elutriated to find the percentage of fine particles (0·01 mm. diameter or less). From this can be calculated the concentration of fine particles in the top liquid layer, and hence the specific gravity reading. It is then necessary to find the settling time to give this reading. The values for the specific gravity of the dry powder must also be known. These are commonly flint and stone 2·5, bone 3·0, low sol. glaze 2·80.

Determination of Grain Size

With the now calibrated hydrometer a similar procedure is carried out to prepare a deflocculated suspension of the material where grain size is required. The fraction of fine material is then calculated from the expression:

$$\frac{1{,}000\ (H - \alpha)}{W} \times \frac{S}{(S - 1)}$$

where H is the hydrometer reading.
S is the specific gravity of the powder.
W is the weight of material taken.
α is a connection factor depending on the deflocculent added.

Where $S = 2{\cdot}5$ and $W = 50$

$$\% \text{ fines} = \frac{1{,}000\ (H - \alpha) \times 100}{30}$$

The values of α are given below.

Deflocculent	*Quantity added (ml.)*	α
2 per cent. sod. oxalate	10	1·00015
2 per cent. sod. oxalate	20	1·0003
2 per cent. sod. oxalate	40	1·0006
2 per cent. sod. oxalate	80	1·0012
4 per cent. Calgon T.	10	1·0003
4 per cent. Calgon T.	20	1·0006

It should be mentioned that in making a determination, increasing amounts of deflocculent are added till the result remains steady or falls. This ensures maximum deflocculation.

Where it is necessary to express the result as a surface factor, and only the percentage of particles finer than 0·01 mm. diameter has been determined the expression,

Surface factor = $(142{\cdot}9 + 8{\cdot}095P) \div S$

is used, where P is the percentage of fine particles and S is the specific gravity.

Light Absorption Method

Where the apparatus is available light absorption offers a method of determining the surface area of suspended particles which is both rapid and results of a high reproducibility of determined values. Its application to ground flint has been described by Miss A. E. Moore (*Pottery Gazette*, **75,** 849, 1950) and to other ground ceramic materials by L. G. Leech, S. W. Ratcliffe, W. L. German, (*Trans. Brit. Ceram. Soc.* **52,** 145, 1953). The latter used the Spekker Photometer for measuring the light absorption. The surface area is calculated from the expression,

$$S = \frac{4}{c.l.} \log \frac{I_0}{I_1}$$

where c = concentration of the suspension.

l = thickness of liquid layer.

I_0 and I_1 are the intensities of light before and after the interposition of the suspension.

With the Spekker Photometer this reduces to,

$$S = \frac{4 \times 2{\cdot}303}{c.l.} (\theta_1 - \theta_2)$$

where θ_1 and θ_2 are the initial and final drum settings.

If the cell is 1 cm. thick and the concentration of the suspension 0·001 gm./ml. and θ_1 is set to 1·0 then,

$$S = 9212\,(1 - \theta_2).$$

The suspension is made up with a deflocculent and a solution of this in distilled water is used as a blank in standardising the apparatus. The suspension is then moved into the light beam and θ_2 determined. Values of S are then calculated. The readings are obtained very rapidly and the method is useful for controlling grinding. The disadvantage is the first cost of the apparatus which is much higher than that of the hydrometer.

Gas Diffusion Method

Materials like cement particles cannot be measured by suspension in water since chemical reactions set in. To overcome this difficulty E. M. Lea and R. W. Nurse (*J. Soc. Chem. Ind.*, **58,** 277, 1939) devised an apparatus for measuring grain size by the resistance to flow of air through the powdered material. The apparatus has been modified by P. J. Rigden (*ibid.* **62,** 1, 1943) and is now available commercially. Essentially the method is to compress a weight of the powder at the bottom of a cylinder and to measure the rate of flow of air through it under a given hydrostatic pressure by turning the rate of fall of a column of liquid. Care is needed in compacting the powder to avoid blow holes. The thickness of the powder in the cylinder is measured by a graduated plunger. Where abrasive metals are used the cylinder and plunger should be of hardened steel. The surface area of the powder is related to the rate of flow of air by the equation.

$$S^2 = 5{\cdot}65 \times 10^6 \frac{\varepsilon^3 T}{(1-\varepsilon)^2 \rho^2 . d.}$$

where S is the specific surface of the powder.

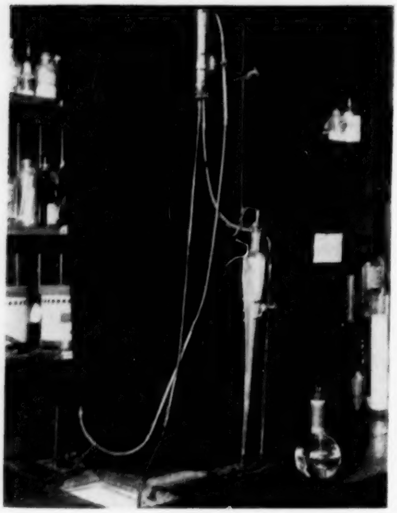
d = depth of powder bed (cm.).

ρ = density of powder (gm. of c.c.)

W = weight of powder (gm.).

A = area of cross section of cylinder (cm.^{2}).

T = time of flow (secs.).



Schöne's Elutriator

$$\varepsilon = 1 - \frac{W}{A\rho d.}$$

ε gives the fraction of voids in the compacted powder.

Schöne's Elutriator

The methods outlined above can be carried out quickly. It sometimes is desirable to do a check on them and then the longer method of elutriation devised by Schöne is used. The elutriator consists of a glass tube, cylindrical in its upper portions and tapering off to a U bend at the bottom. The latter serves to connect it to a water supply. An outlet tube can be fixed at the upper end. The cylindrical portion should be of uniform cross section and this is checked by adding increased volumes of water and measuring the rise in level. This also serves to evaluate the area of cross section. The sample is weighed and boiled, etc. as in the the other methods and sieved through 100's and 200's lawns; the residues being collected and weighed. The remainder is washed into the elutriator and treated with a current of water just strong enough to wash over the particles 0·01 mm. or finer. This is a slow business and is usually done overnight. The residue in the elutriator is then dried and weighed, and by difference the weight of fine material elutriated is obtained. The water velocity is given by Schöne's empirical formula

$$V = 104{\cdot}7\ (S-7)^{1{\cdot}37}\ D^{1{\cdot}37}$$

where S is the specific gravity of the solid and D its diameter in mm. Where S = 2·5 and D = 0·01 the required velocity is 0·143 mm./sec. If this velocity be multiplied by the area of cross section of the upper part of the tube the volume of water over flowing in a given time can be calculated. The velocity of water is, therefore, adjusted by measuring the overflow in a given time. To cut out pressure fluctuations the water in the elutriation is supplied from a service tank maintained at a constant level.

The Andreasen Pipette

This is sometimes used instead of Schöne's elutriator as a control on more rapid methods of grain size determination. It depends on sedimentation and consists of a glass tube dipping in a cylinder of known dimensions. The end of the tube is always at a constant depth below the surface and this is arranged by fusing the pipette tube into a ground glass stopper fitting in the neck of the cylinder. The tube is joined to a bulb holding a given volume of liquid, which can be run out into an evaporating dish by a three way tap. By withdrawing samples at different times (calculated from Stoke's Law) and evaporating and weighing the the solids the fractions of particles of different sizes can be obtained. Corrections are made for the falls in level due to the withdrawal of successive samples. For full details the reader is referred to an article by A. H. M. Andreasen and J. J. V. Lundberg (*Ber. deut. keram. Ges.*, **11**, 249, 1930).

INTERNATIONAL CERAMIC CONGRESS

The Fourth International Ceramic Congress will be held in Florence, Italy, from 27th September to 2nd October. The provisional programme divides the congress into two parts. The first, which is optional, consists of visits to a variety of factories connected with the ceramic industry; the second contains four technical sessions and will take place in Florence from 29th September to 2nd October.

Swedish Glass Exhibition

by

JOHN GRINDROD, B.A.(Com.)

NEARLY a quarter of a century after the international exhibition in Stockholm in 1930, which opened the eyes of the world in general to what has since been known as the "Swedish Modern" style of interior decoration, another landmark in the display of Swedish artistic work has recently been opened in the National Museum, Stockholm, in the form of a wide and interesting collection of glassware from eighteen Swedish glassworks.

Sponsored and arranged by the Swedish Association of Industrial Design and the National Museum's Department of Industrial Art in collaboration, the exhibition, which is to last throughout the summer and which is expected to be one of Stockholm's artistic attractions during the tourist season, has been planned in its architectural form by the well-known Swedish expert Gunnar Myrstrand. Contributing greatly to the aesthetic atmosphere of the displayed exhibits, the rooms in the nearly 100-year-old Museum have been tastefully arranged in a simple modern style. The architect has used plain, untreated oak alternating with glass shelves to carry the exhibits, while Swedish glass fibre cloth has been used to cover the walls and, for drapings, only plain material or simple geometrical patterns are being employed All has been arranged with an eye to letting the glass tell its own story. Plain lighting fixtures in frosted milk glass from the Pukeberg glassworks and a number of comfortably low stools of the new wide-seat square type just launched by Dux, a firm of Swedish furniture manufacturers, complete the interior.

Among the products of the eighteen glassworks displayed at the exhibition are those from Sweden's outstanding Orrefors and Kosta works as well as pieces from a number of smaller and less well-known firms. As well as ornamental glassware are to be seen utility pieces. Both classes, in a well-balanced display, bear witness to the fact that in spite of changes in fashion which have taken place since the 1920s—the famed era of Sweden's glass industry—glass still holds a foremost position in the country's artistic life and that competition in this field has held development at a high level. Old techniques have been revived in the manufacture of modern ware and a great many new ones added.

Among the displayed pieces evolved by new methods is the "Fuga" series made by Orrefors, who by a novel technique are producing crystal bowls and vases at the price of plain earthenware vessels. Using a patented process for centrifugally moulding the vessels, its inventor, Sven Palmqvist, has succeeded in making household utensils beautiful enough to serve as decorative objects, the wares acquiring a finish closely resembling that of hand-blown pieces. Smooth heavy edges and the absence of abrupt joinings of walls and bottom make them particularly easy to wash—a fact which has been recognised by the Swedish Institute for Domestic Research.

Although by no means among the oldest of Swedish glassworks, Orrefors has perhaps become the most widely known, due in great measure to the artistic abilities of Johan Ekman, who acquired the works some forty years ago, and to the inspired work of the late Simon Gate, its first artistic director, who developed the engraving technique

Glass-blowers at work in Orrefors glass works

for which Orrefors has become specially famed. It was such men as Simon Gate and Edward Hald of Orrefors and Ivar Kåge of Gustavsberg, designer of fine ceramics, who helped to pioneer Swedish industrial art at the time of the 1930 Stockholm Exhibition.

Of these two Orrefors designers, Edward Hald is still active and specimens of his work are displayed on the shelves of the present Stockholm Exhibition. He is now assisted by Sven Palmqvist, Edvin Ohrström, Nils Landberg, John Selbing and Ingeborg Lundin, their youngest designer and the only woman in the group. In their quest for rejuvenation the Orrefors artists have concentrated a great deal on new types of coloured and cased crystal, among which the Grail and Ravenna types have become best known. Nevertheless, there is still a steady demand for engraved glass, especially from abroad, and there has been an urge for a return to the uncoloured translucent glass with engravings and etching as the only decorative elements. New techniques have been evolved within this field, and, in keeping with modern art trends, the designers have turned to abstract symbols and designs rather more than to the epic and lyrical subjects that were the source of inspiration at the beginning of the Orrefors era of fame.

At the exhibition probably the most advanced approach to art by the Orrefors team is reflected in the work of Ingeborg Lundin. Mrs. Lundin often uses unconventional shapes and rarely uses anything but uncoloured glass. Ornamentation is sparingly applied, sometimes altogether omitted. For instance, her plain vases are surprisingly charming, the newest representing a bulb with a very slender neck. The bulb is somewhat perforated in the manner of a strawberry barrel by eyelets for single flowers round the top part below the neck.

Among the exhibits of the Kosta factory, another well-known Swedish glassworks, are pieces by Elis Bergh and Viche Lindstrand, who are represented by a variety of techniques. The former is represented mainly by his well-balanced classic services, while

Lindstrand has displayed various fine engraved pieces and a number of cased types.

Viche Lindstrand was originally a ceramic artist, but switched from ceramics to glass. So, too, have Gunnar Nylund, of Strömbergshyttan, and Arthur Cason Percy, now with Gullaskruf, both of whom are represented at the exhibition with some very good pieces. Other designers, also well to the fore, are Erik Höglund, of Boda Bruk, Bergt Edenfolk, of Skuf, and Bengt Orup, of Johansfors. There is a fine display to honour the memory of the late Hugo Gehlin, of Gullaskruf.

Apart from Ingeborg Lundin, of Orresfors, two other women designers give a mark of distinction to the exhibition. They are Gerda Strömberg, of Strömbergshyttan, veteran designers of that firm's well-known, heavy, smoke-tinged crystal, who has made a number of new pieces of striking freshness, and Monica Bratt, artistic director of Reijmyre, who presents her own speciality of ruby and emerald green glass in down-to-earth, simple forms.

Showing evidence of the great attention being lavished on utility as well as ornamental pieces are, for instance, such exhibits as drinking glasses from Boda, Björkshult and Glimma, a series of beautiful jugs from Åors, salad bowls and platters from Målerås, Ekenäs and Gullaskruf. Many of the lesser known works exhibit specimens of their table ware series, which are finding a market abroad, especially in the restaurant trade. Being shown are etched emblems from London's Carlton Hotel and other overseas hotels, clubs and restaurants from as far afield as Karachi and Port Elizabeth.

One of the recent designs by Sven Palmqvist, of Orrefors

A feature of the exhibition, which will continue throughout the season, is a delightful eye-catching arrangement of cut-flowers along an entire windowed wall. In these decorations the glass designers themselves will vie with prominent florists in showing their skill in the art of blending the beauty of the flowers with that of the vases in which they are displayed.

NEW ELECTRIC KILN FIRES CHINA BISCUIT

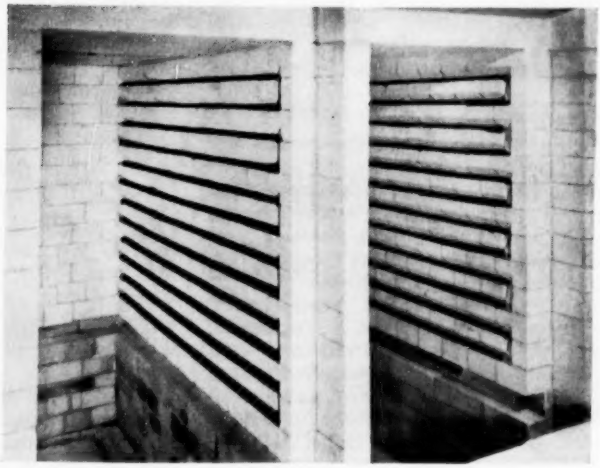
A DEVELOPMENT which promises to be of considerable importance to the pottery industry—a new intermittent electric kiln for the biscuit firing of china—was announced in a report issued this month (28th May) by Mr. H. A. P. Caddell, Manager of the North Staffordshire Sub-Area of the Midlands Electricity Board. This new kiln has been designed jointly by Mr. S. Scholefield, A.M.I.E.E., the Sub Area Commercial Officer, who has for many years been interested in the application of electricity to the pottery industry, and Mr. Donald Shelley, M.A.(Cantab) of Shelley Potteries Ltd., Longton, manufacturers of bone china. Mr. Caddell's report recalls that in July last the M.E.B. announced the construction by Spencer Stevenson & Co. Ltd., of Longton, of twin electric decorating kilns to the design of Mr. Scholefield. These kilns, each 2 ft. wide, 4 ft. 6 in. long and 3 ft. 6 in. high, have proved entirely successful for the firing of china decoration at temperatures between 650° C. and 750° C. and as a test they have been taken up to the glost firing temperature of 1080° C.

After a visit to these decorating kilns, Mr. Shelley asked Mr. Scholefield to co-operate with him in the construction of an experimental kiln to fire china biscuit. It was decided to go ahead immediately with the experiment and assistance was called for from the British Ceramics Research Association and from the Morgan Crucible Co., of Neston, Cheshire. Within two months, construction of a kiln was completed at the premises of Shelley Potteries Ltd., electrical equipment being loaned and installed by the M.E.B.

Kiln Construction

The kiln constructed is 9 ft. long, 2 ft. wide and 3 ft. 6 in. in height, with two trucks, each 4 ft. 6 in. long, each with its own brick door, to enter the kiln at opposite ends. The kiln, trucks and doors are lined with insulating bricks of the highest grade (M.I.28) supplied by the Morgan Crucible Co. which are reasonably good electrical insulators at high temperatures. These bricks are backed with a layer of lower grade insulating bricks, and the outside is cased with ordinary building bricks.

Electric kiln showing twin chamber construction with a truck in the firing position



A close-up of the element arrangement of the twin chamber electric decorating kiln

The heating elements used in this kiln are constructed from Kanthal A.1 (10 SWG) wire—an alloy of iron, aluminium, cobalt and chrome. About 120 lb. of this wire was installed at a cost of 35s. per lb. Recessed into the walls of the kiln are fifteen elements on each side, with a loading of 5·7 watts per sq. in., and there are three additional elements built into the deck of each truck, and ten in each door, with the object of providing a uniform firing temperature throughout the kiln—an important factor in the successful firing of high grade china. Firing is controlled by an automatic switch which is pre-set to the required temperature of 1250° C., and a safety device ensures that the trucks, with their built-in heating elements, cannot be removed while the power is switched on. There are two small outlets in the roof of the kiln to allow moisture to escape during, the early stages and the fluorine during the later stages, and for cooling purposes. There are also three trial holes in each door, through which heat indicators can be observed, for use as a check in the firing and trials withdrawn at any stage in the firing. No fans are required during the firing or cooling of the kiln. The kiln has a capacity of about 150 doz. cups, or about 200 doz. saucers, or sixty doz. of large flat fired in single setters. The ware is placed on furniture supplied by the Acme Marl Co., and is fired in between 23 hr. and 24 hr. and cooled in about 18 hr. By the use of spare trucks, the kiln has a firing cycle of 48 hr., and can, therefore, be fired three times during the working week. It is intended that these kilns should be built in pairs, so that a continuous electric load is taken, one kiln firing while the other kiln is cooling, and as one kiln is fired up and switched off, the other one is switched on. Electricity consumption averages about 1,250 units per firing at a cost of ·9d. per unit, giving a fuel cost of £4 10s. Fuel costs, therefore, compare favourably with the coal fired intermittent oven, as about nine firings of this small kiln give an equivalent output of one 14 ft. coal oven.

Successful Trials

This experimental kiln has now been fired nearly fifty times, with great success and with no signs of deterioration of either the brickwork or the wire elements. It is intended to continue firing the kiln until at least 100 firings have been completed, so that the life of the elements and the brickwork can be fully tested. Many pottery manufacturers have seen the kiln in operation and have had trial firings of their ware in it, and Wade Heath & Co. Ltd., of Burslem, have already begun on construction of a double unit for the firing of their earthenware biscuit up to a temperature of about 1,150° C. Two firings have been made of large fire-

clay kitchen sinks on behalf of another manufacturer, who is building himself a kiln with which to carry out further experiments.

Future of Kiln

It is hoped that the part which the M.E.B. has played in the development of this new kiln will prove to be a contribution to the future efficiency of the pottery industry, and the Board is grateful to Shelley Potteries Ltd. for their co-operation in attempting something which many experts felt could not be achieved, and the success of which has been beyond their own expectations.

Commenting on Mr. Caddell's report, Mr. Norman Shelley, senior member of Shelley Potteries Ltd., said "This kiln is giving a wonderful result. We have fired every kind of china biscuit in it, and I think it is the answer for firms which, like ourseles, place quality first in the firing of bone china. The loss from this kiln is very small and cannot be blamed on the firing, and we estimate that the total cost of firing in these kilns, including repairs and replacement of furniture, will be about half of that of our present coal ovens. No saggars are needed, no night work, no week-end work, no holiday work, and no casual labour is required for drawing. A two-truck kiln can easily be emptied and refilled by one placer within the day. This kiln can easily be constructed by smaller manufacturers with insufficient room in their factories for the present tunnel ovens and its use will contribute to smoke abatement. The capital outlay in building a battery of these kilns is very much less than for a tunnel oven of equivalent capacity, and they can be built one at a time and brought into commission without disturbing the output of the factory. We are already working on a plan to construct a number of these small kilns and we intend gradually to change over our firing from our present coal ovens to these electric intermittent kilns as they are constructed.

"One great advantage of this method of firing is that each type of ware can be fired separately to receive the correct heat treatment and to develop maximum translucency, maximum strength and minimum porosity. All the disadvantages of the tunnel kiln are eliminated—the pile-up and loss of output during repairs, the problem of maintaining temperature during holiday periods, and the annual overhaul during the Wakes week."

Mr. Shelley added that his firm had just completed the construction of two intermittent electric decorating kilns, based on the design already used by Spencer Stevenson & Co., for the firing of special decorated ware which needed a higher temperature firing than normally used in their present continuous kiln.

Firms Co-operating in Construction

The Midlands Electricity Board acknowledge the help and co-operation of the following firms in the construction of the new kiln: Morgan Refractories Ltd. (insulating bricks); Brentford Transformers Ltd. (low voltage transformer); Bramall (Engineers) Ltd. (trucks and ironwork); Hall & Pickles Ltd, (Kanthal); Ether Ltd. (temperature control); E. N. Bray Ltd. (contactors); and Acme Marl Co. Ltd. (kiln furniture).

"GRAFTON" POTTERY KILNS

With the co-operation of the South-eastern Sub-area of the London Electricity Board, **The Applied Heat Co. Ltd.,** Elecfurn Works, Watford By-Pass, Watford, Herts, staged an exhibition of "Grafton" pottery kilns in the Showroom at Electricity House, Erith, from 11th to 18th May.

The day before the exhibition opened, Mr. W. H. Chapman, Chief Designer of The Applied Heat Co. Ltd., lectured to two parties of students in the adjoining lecture hall on pottery and kilns. The exhibits were primarily of interest to studio potters, and included a selection of fine ware, loaned for the occasion by the pottery section of the Woolwich Polytechnic, which has been using "Grafton" kilns for some years. Large equipments, etc., were illustrated by means of photographic enlargements. Considerable local interest was aroused by the exhibition, which fully justified the assertion that the study of pottery is arousing increased interest throughout the country.

High-Voltage Ceramics

INSTRUMENTS such as radio, television, X-ray and other high frequency electronic equipment utilise a large quantity of ceramic insulators which can operate at high temperatures with low power losses. These dielectrics should have both high resistivity and high dielectric strength.

When used for insulating purposes only, the ceramics should have a low dielectric constant in order to minimize the power loss and, in radio receivers, to prevent poor selectivity. When used as a dielectric in an electrical condenser, however, the ceramic material must have a high dielectric constant in order to get sufficient capacitance in a small unit. High dielectric strength and high resistivity make possible small resistors and capacitors, and size is of great importance in radio equipment.

In transformers, where high energy is generated, insulating materials with high power factors will generate much heat which may result in the complete destruction of the insulators.

Several mechanical properties are also important. The ceramic material should have a smooth, non-absorbent surface as well as high mechanical strength and relatively low thermal expansion. The ceramic material should also be easily formed and shaped close tolerances.

In many of the specialised applications, one or more specific requirements may take preference over others and dictate the final choice of the material to be used. In order to meet the wide range of special requirements, a number of types of low-loss ceramic insulating materials are now being produced. They are steatite, cordierite, rutile, titanate and zircon bodies.

Steatite Bodies

Steatite is a mineral compound almost entirely composed of cryptocrystalline talc ($3MgO \cdot 4SiO_2 \cdot H_2O$). In order that it may be suitable for low-loss ceramics, steatite should contain only small amounts of impurities. For example, iron oxide should not exceed 1 per cent., lime 1·5 per cent. and alumina 2 per cent. Excessive amounts of iron oxide cause high dielectric losses at high frequencies. High lime content shortens the firing range of the body and slightly lowers the power factor, while an excess of alumina tends to form a glass which increases the power loss.

Steatite talc has long been used as a major ingredient in low-loss insulators and representative compositions of such bodies are listed in Table 1.

Talc is the chief ingredient in each of the bodies with just enough clay to provide the necessary green and dry strength and to permit maximum density when the talc fuses (at about 2,740°F). Feldspar is the usual flux; a potash spar is preferable to soda spar, as the latter has a detrimental effect on the power loss.

Steatite bodies can be formed by the conventional ceramic methods of passing and/or extrusion.

The firing of these bodies to the point of vitrification is normally done in kilns such as glow-bar-heated, gas

TABLE 1.

Body Designation	*A* per cent.	*B* per cent.	*C* per cent.	*D* per cent.
Steatite talc	90	88	85	86
Potash Feldspar	5	—	2	4
Clay (kaolin)	5	5	13	10
Barium Carbonate	—	6	—	—
Calcium Carbonate	—	1	—	—
Firing temperature, Cone ...	13½	13	13	14

TABLE 2.

Specific gravity, gram./cu.	2·5-2·8
Moisture absorption, per cent.	0·0-0·1
Coefficient of linear thermal expansion (20° C. to 700° C.)	7·8-10·4
Safe operating temperature, ° C.	1,000
Tensile strength, p.s.i.	6,000-13,000
Compressive strength, p.s.i.	65,000-130,000
Transverse strength, p.s.i.	14,000-24,000
Thermal shock	Fair
Power factor at 1 megacycle	0·0026-0·0011
Loss factor	0·0152-0·0071
Dielectric strength, volts/mil.	250-350
Resistivity, ohm./cm³.	1,013-1,015
Dielectric constant at 1 megacycle	5·86-6·51

fired, and oil-fired car tunnel kilns equipped with automatic temperature controls. Firing is normally carried out in oxidising atmosphere in accordance with the following typical schedule: heat the bodies to peak temperature in 6 to 6½ hrs. The soak at peak temperature should last from 1 to 2 hrs., followed by cooling of the bodies to room temperature in from 6 to 10 hrs.

This class of material is designed as Grade L ceramic radio insulating material and should meet most requirements. In most requirements a maximum value for the loss factor is specified. (The loss factor of an insulating material is defined as the product of its dielectric constant and the tangent of its loss angle. The tangent of the loss angle is considered equal to the power factor.) The average loss factor for six different specimens which have been immersed in distilled water for 48 hrs., should not exceed the following values when measured at a frequency of 1·0 megacycle per second.

Grade	*Loss Factor*
L1	0·150
L2	0·070
L3	0·035
L4	0·016
L5	0·008
L6	0·004

Most commercial grades of steatite fall in grade L4 or L5. The grade L6 is rarely manufactured.

Some of the physical and electrical properties of steatite bodies produced from the previously mentioned compositions are as in Table 2.

Cordierite Bodies

Cordierite is a mineral with the composition $2MgO{\cdot}2Al_2O_3{\cdot}5SiO_2$. Although this substance has never been found in any sizable natural deposit, cordierite crystals can be developed in a ceramic body of the following composition: talc 39·6 per cent., clay (pure kaolin) 47·0 per cent. and alumina 13·4 per cent. Bodies which approach the theoretical composition, however, are very difficult to handle because of their extremely short firing range.

When fired just below the vitrification temperature bodies having theoretical composition are porous and have very poor mechanical strength, but they exhibit extremely low thermal expansion ($1{\cdot}0 \times 10^{-6}$ in the range 20°C. to 300°C.). Because of this low thermal expansion they are able to withstand high thermal shocks. These bodies are usually used for electrical heater plates and cores of electrical resistors. When fired past the fusion point, vitrification occurs very suddenly at about 1,450°C., thus producing a very fluid $MgO\text{-}SiO_2$ liquid which usually leads to severe difficulties with warping.

In order to cushion this sudden melting effect and make it possible to fire cordierite bodies in commercial tunnel kilns, some other material, such as zircon, is added to the batch. Zircon lengthens the firing range and improves the dielectric properties. However, the thermal expansion of the body rapidly increases when the theoretical composition of cordierite is altered. One authority[1] gives the following as a commercial cordierite body composition:

[1] *Stone, R. L. North Carolina State College, U.S.A.*

Component	*per cent.*
Steatite talc	29·7
Plastic kaolin	35·3
Corundum	10·0
Zirconia	25·0

Bodies of this type, consisting of 60 per cent. cordierite crystals with the balance chiefly zirconium silicate, have very good resistance to thermal shock. However, their low thermal expansion makes it impossible to glaze to such bodies in the usual manner; any glaze composition would have a much greater coefficient of expansion. This difficulty may be avoided by adding a small quantity of a glass-forming flux which produces a self-glaze on the surface during the firing operation.

Dense cordierite bodies having virtually zero porosity when fired between 1,285°C. and 1,325°C. have been developed. These bodies were obtained by using calcined blends of $MgCO_3$, talc and clay. These bodies are also characterised by low thermal expansion, good mechanical strength, and excellent thermal-shock resistance.

Cordierite is used in the electrical field primarily for the production of coil forms and for resistance wire supports in various types of equipment. Such coil forms are especially useful in radio because they do not alter their dimensions with temperature changes; hence the coil inductance remains practically constant.

Rutile Bodies

The mineral forms of titania (TiO_2) have certain desirable electrical properties which have been utilised in low-loss ceramic dielectrics. Chief among these is rutile. This material has a dielectric constant of eighty-nine perpendicular to the crystal axis and 173 parallel to it, with a mean value of 114. Another important characteristic of rutile is that, unlike most other minerals, its dielectric constant decreases with increasing temperature. This means that rutile capacitors can be connected to conventional capacitors to produce a combination with a fixed dielectric constant over the entire range of operating temperatures. This feature is of great value in tuned radio circuits.

Unfortunately, it is very difficult to vitrify TiO_2 without the use of fluxes. Hence, the preroasted rutile crystals are mixed with a small amount of feldspar, clay or other fluxes. However, even small amounts of these materials lower the dielectric constant and increase the power factor, so that commercial rutile bodies have a dielectric constant of about eighty-five. One such body investigated had the following composition:

Component	*per cent.*
Titania	90·00
Calcium-titanium silicate ...	3·33
Magnesium oxide	3·33
Beryllium oxide	3·33

This body has a power factor of only 0·00036 at 1,000 kc., dielectric strength of 144 volts/mil and a linear coefficient of thermal expansion of $7{\cdot}2 \times 10^{-6}$ in the range of 100°C. to 500°C.

Rutile bodies of this type often show firing shrinkage as high as 27, but are very dense and strong. High mechanical strength, high dielectric constant and low power factor are the reasons while rutile ceramics have been so useful in the manufacture of fixed condensers and trimmer condensers in radio receivers and other applications where capacitance is the primary consideration. More often than not, the negative capacity coefficient of rutile is used to compensate for the positive coefficient of other condensers in the circuit.

Titanate Bodies

A number of special bodies are made by using 60 per cent. to 90 per cent. rutile with one or more of the following oxides: MgO, ZrO_2, BaO, PbO, BeO. The titanate bodies, of which manganesium orthotitanate is typical, are characterised by extremely low dielectric losses.

Although the dielectric constants of most of the titanate bodies are considerably lower than that of rutile, their variation with changing temperature is so small (-20×10^{-6} to -30×10^{-6} per degree C.) that such bodies are often preferred in oscillatory circuits for radio equipment.

A discussion of titania ceramics for electrical uses can be divided into three main classes: (1) a class based chiefly on high-titania compositions in which titania is present substan-

TABLE 3.

Body	A per cent.	B per cent.	C per cent.	D per cent.	E per cent.
Zirconium silicate	59·25	66·7	68·5	59·2	35
Calcium-zirconium silicate	7·41	22·2	22·6	29·6	20
Magnesium silicate	7·41	—	—	—	10
Barium-zirconium silicate	7·41	—	—	—	10
Clay	18·52	11·1	8·9	11·2	25
Dielectric constant ...	8·2	9·4	9·4	8·6	8

tially as rutile, (2) a class based chiefly on high-titania compositions in which titania is present substantially in some crystalline form other than rutile, and (3) a class in which at least a minute proportion of the titania is present in the reduced state.

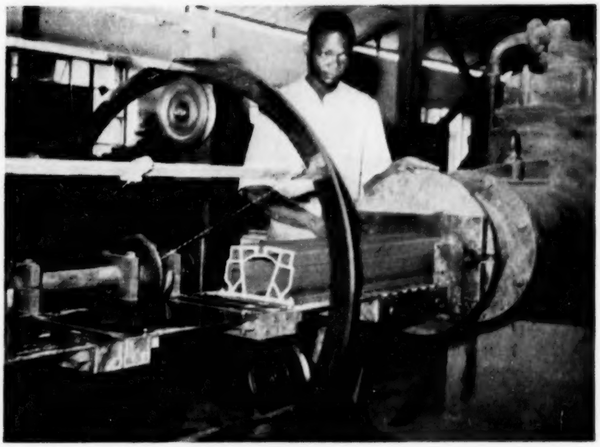
Considerable data have been published concerning the various types of titania bodies. Their high dielectric constants are of tremendous importance when they are to be used in high-capacity condensers in air-borne radio and radar equipment. A titania condenser has a capacity about 200 times that of one of the same size made from porcelain, glass, mica or steatite.

Zircon Bodies

Much work has recently been done on zircon porcelains in an attempt to develop low-loss ceramic dielectric materials which could be fabricated by conventional whiteware forming methods and fired in large commercial tunnel kilns without excessive loss of the finished product. The firing range of steatite and other types of insulating ceramics is so short that special small kilns must be used, and extreme care is required to hold finished-product losses within economic limits. The low loss zircon porcelains, on the other hand, have firing ranges of at least 200°F. They are dense throughout that range; thus, the danger of obtaining underfired or overfired wear is largely eliminated. It is probable that insulating parts of low-loss zircon porcelain can be made satisfactorily in any well-managed whiteware plant without any special equipment. A number of zircon porcelains have been investigated and the following have been found to have good electrical characteristics. (Table 3.) All five of these bodies may be satisfactorily matured in the temperature range of cones No. 10 to 12 and show total firing shrinkage of 15 per cent.

Quickfit and Quartz Ltd.—Chemical glassware produced by Quickfit and Quartz Ltd., of Stone, Staffs, a member of the Triplex group of companies, was among items shown at the Exhibition of Scientific Aid to the Dyeing Industry, arranged in the Great Hall of Leicester College of Technology by the Midlands section of the Society of Dyers and Colourists recently.

The exhibit included basic ground joint assemblies for chromatography, with emphasis on column chromatography; extraction apparatus with particular regard to liquid/solid extraction; Soxhlets, ranging from the semi-micro scale to the largest sizes; filtration apparatus including Gooch-type filters; a semi-micro "pocket laboratory" set with stand; and further recent developments, including the Craig Machine for the extraction of similar substances for dilute solutions.



Uganda's modern clay factory: Clay is extruded through a die to form cellular blocks

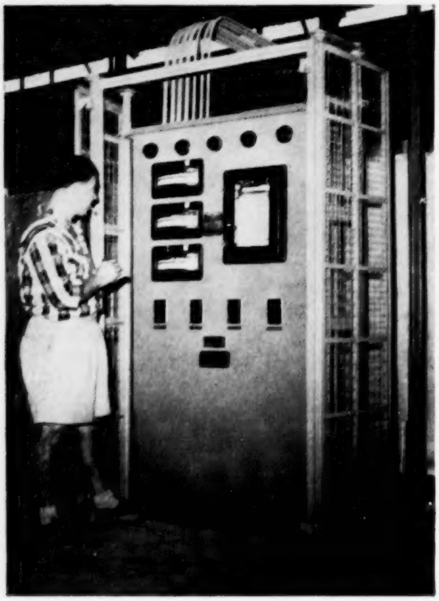
First Electric Tunnel Kiln in E. Africa

Housing Problem Overcome

UGANDA faces an acute housing shortage, particularly in Kampala, Jinja and Entebbe. Although last year just under 200 units of European housing and 169 of Asian housing were completed, while a further 152 European and ninety Asian units were under construction, the provision of adequate buildings has not kept abreast of the great economic development of the country accompanying the inauguration of the Owen Falls Hydro Electric Scheme. One difficulty has been the necessity of hauling imports of building materials some 750 miles from Mombasa, the nearest port. To overcome this bottle-neck in the Protectorate's housing scheme, and meet the demand for cheap and speedy building, the Uganda Public Works Department has decided to make its own tiles and cellular blocks. For this purpose, an electric kiln has been erected at Jinja where there is a good supply of suitable clay as well as adequate power from the Owen Falls Hydro Electric Scheme.

The kiln, the first all-electric tunnel kiln to be installed in East Africa, is capable of firing 5,000,000 lb. of products per annum, at a temperature of 850° C., and was designed and built in England by **The General Electric Co. Ltd.** Its

Products entering the kiln. Bogies are propelled through the kiln by a hydraulic ram which can just be seen on the left of the picture



Automatic temperature control panel for the 100-ft. tunnel kiln. The pyrometer controls are on the left and the recorder on the right with the push buttons along the bottom

erection on site, together with the erection of the necessary buildings to house it, was carried out by the Uganda Public Works Department, using direct labour consisting of African and Asian craftsmen, supervised by Europeans, an African engineering assistant and African porters.

The kiln, which has preheating, firing, and cooling sections, has an effective length of 100 ft. Heating in the kiln is by nickel-chrome elements 0·20 in. dia. formed into 1¾ in. dia. spirals, each of which rests in refractory brickwork grooved to receive it. The firing section has automatic temperature control and is divided into three zones each fitted with a pyrometer and fed by a Scott-connected transformer which gives a voltage on the secondary side variable from 103 volts to 126 volts, 2 phase, the incoming voltage being 415 volts, 3 phase. Each zone is rated at 3 kVA. For further flexibility, the outgoing supply from the transformers feeds three sets of bus-bars on either side of the kiln. It is thus possible to vary the heating arrangements simply by changing the connections from the elements to the bus-bars by means of specially shaped links.

Bogies which carry the clay products through the kiln have side-angle runners which move in a sand trough to effect a furnace seal. Products are stacked directly on the refractory hearths of the wagons to a height of 3 ft. above hearth level with a width of stack of 18 in. No spacing pieces between wares are necessary. For stability, cellular blocks are stacked first, and roofing tiles above them. The wagons are pushed through the kiln by an automatically-controlled hydraulic ram. When a fresh wagon is pushed into the kiln all the wagons move along one space and a fired wagon is pushed out of the discharge end.

An ingenious arrangement, by which exhaust air from the kiln is used to preheat the clay to 100° C., prevents cracking from over-rapid heating. Although

(*Continued on page* 176.)

Examining the spiral elements in the firing section of the tunnel kiln

Ceramics in India

A Review of 25 Years Progress

EARLY this year the Indian Ceramic Society celebrated its Silver Jubilee at which a symposium was held on "The Ceramic Raw Materials of India" as reported in our March issue. At that meeting the President of the Society, Dr. Atma Ram, reviewed the progress of the ceramic and glass industries in India over the past twenty-five years, and went on to speculate on and to a certain extent predict the future of the industry in India.

Extracts of Dr. Ram's speech, which should prove of interest to our readers, are printed here.

Progress of the glass and ceramic industries in India during the last twenty-five years

While reviewing the progress of the Society made during the last twenty-five years, it will be appropriate to mention developments in India in the related industrial fields. In 1928 India was producing glass goods worth about rupees one and half crores, out of which a very major portion was accounted for by the glass bangles which is one of the biggest cottage industries of the country concentrated at Firozabad near Agra. The articles produced were bangles, chimneys, globes, jars, tumblers, bottles, sheet glass, etc. The total production is stated to have been about 4,000 tons to 5,000 tons per annum. On account of the encouragement given to the Indian industry by the Swadeshi movement and after the outbreak of the World War II, several new factories were started and the production of existing ones very considerably increased with the result that in 1944 the total production of glass was about 120,000 tons valued at about rupees eight to nine crores. The total number of workers employed in the industry had reached about 25,000 to 30,000. The scope of production also increased and laboratory glassware chemically resistant glass tubings, beads, etc., were successfully produced. The number of sheet glass factories increased from one to three and there is a fourth expected to go into production very shortly. In most classes of manufacture such as glass bangles, bottles, sheet glass, etc., the production capacity is enough to meet the country's demands. There has been considerable change in the methods of production as well. For instance, whereas in 1928 there were only three or four tank furnaces, their number today is about fifty. With the exception of bangle industry, there are not many factories that have pot furnaces and these are for special production. A number of factories have introduced annealing lehrs but the annealing kilns are still quite common. Mechanisation by the introduction of semi-automatic machines has been fairly extensive and about half a dozen factories have installed automatic machines for the production of bottles and pressed ware. For the production of sheet glass, some of the factories are quite modern, and up-to-date machinery and furnaces have been installed. Efficiency of production and quality of goods produced have improved very considerably.

The total annual production of pottery goods in 1928 is stated to have been worth about twenty-five to thirty lakhs of rupees. The articles produced were domestic crockery, low tension insulators, acid jars, floor tiles, etc. There has been a very considerable expansion in this industry as well. The total production has increased very considerably and was estimated to be about rupees 2·5 to 3 crores in 1945. Similarly the range of the articles produced has increased not only in domestic crockery but also in the new items of production such as high tension insulators, wall tiles, sanitary goods, etc. The equipment and methods of production have become fairly modernised in several units and the biggest pottery factory in the East is in India. Whereas in 1928 most of the furnaces were of the down-draught kiln type, at least three works have installed up-to-date tunnel kilns for mass production. The efficiency of these furnaces is considered to be comparable with those attained in other countries. The quality of the articles has very much improved.

The enamel industry in India started during the twenties and the twenty-five year period almost coincides with its existence. It was pioneered by two of our past residents—Col. D. N. Bhattacharjee and Sri M. M. Sur. There are now about a dozen enamel works spread over the country. The total production which was worth about rupees one to one and a half crores during the war declined after partition of the country. A variety of articles comprising household ware, hospital ware, enamel signs, sanitary ware,

etc., are being produced. The quality of the articles is good.

In India the refractory industry has as the chief consumers of the products and the steel works and other metal industries, and naturally its expansion is guided by developments in these industries. It has very securely established itself during this twenty-five years period and there has been some expansion also. The total productive capacity is now about 200,000 tons.

Establishment of teaching and technical departments and research institutions

In the technical and educational field there was an important development in 1940 in the establishment of the Indian Section of the Society of Glass Technology, England. Its membership is fairly substantial and countrywise India stands third, U.K. and U.S.A. being the first and the second. It has helped in bringing together the glass manufacturers and in creating an attitude of collaboration amongst them.

Impressed by the expansion of the ceramic industries and the necessity of training technical men, two other universities, Calcutta and Osmania, introduced courses of silicate technology in their M.Sc. degree. The Foreman Christian College, Lahore (now part of Pakistan) had already instituted a course of ceramic teaching in their graduate and post-graduate courses of chemical technology. Workers trained at these institutions and at the Banaras Hindu University have formed the technical personnel for most of the factories in India, and judged from the work they have done, they have been quite useful to the industry. The Bengal Government established the Bengal Ceramic Institute at Calcutta in April, 1941, for training artisans and technicians, which function it is performing till today.

Taking the clue from the recommendations of the Tariff Board on the Glass Industry (1931) for the establishment of a Central Institution for glass technology as a necessary requirement of protection, the U.P. Government created in 1938 a Glass Section attached to the Directorate of Industries to assist the glass factories and placed it in charge of a Glass Technologist to the Government. Its headquarters were first located in the premises of the Banaras Hindu University so that its facilities both of equipment and staff could be helpful to the adjacent department of glass technology, but after the outbreak of war, it was shifted to Kanpur in 1942 and has continued to function from there. The Government of Madras also established a section of glass technology in the charge of a Glass Technologist.

Even with all these facilities, the need of a central institution for glass and ceramics was felt, and more keenly so during the war period when the opportunities for expansion of the industries were very great. It was to fulfil this want that in 1944 the Council of Scientific and Industrial Research decided to establish the Central Glass and Ceramic Research Institute at Calcutta with fairly objective functions. The progress in the beginning was rather slow but with the patronage that science and technology have received from Prime Minister Shri Jawaharlal Nehru and the influence and drive put into this movement by our eminent scientist, Dr. S. S. Bhatnagar, the progress of the establishment of National Laboratories was accelerated. This movement can well be compared to the establishment of Kaiser Wilhelm Research Institutes in Germany. The Institute was formally opened in August, 1950, and has been functioning actively since then. It has a fairly extensive programme covering glass, pottery, enamel and refractories and the basis of its policy is to concentrate on selected items rather than spread out over a vast field of interest. Considering the present requirements of the country, its activities are predominantly directed to industrial problems although a good amount of fundamental research is also in progress. It is not for me, as the head of that Institution, to speak about its achievements, and I leave that task to our friends. I would only say this much; that apart from its own research activities, during the few years of its existence it has been able to create an appreciation of the value of scientific approach to industrial problems.

During the last stages of the war, the Government of India became particularly interested in post-war planning and a Department of Planning and Development was created at the Centre with the late Sir Ardeshir Dalal, one of the illustrious leaders of the Indian industry, as the Member of the Viceroy's Executive Council in charge of it. A number of panels to draw up plans for the future development of industries were appointed by this Department, out of which two were constituted, one on glass and the other on ceramics and refractories, with the late Mr. I. D. Varshnei and Mr. M. G. Bhagat as Chairman respectively. It is interesting to mention here that some of the past Presidents of the Society as also the present served on these panels. The panels submitted elaborate reports and one of their common recommendations was for increasing the facilities for research and training. It may be mentioned that several of the measures that have been adopted in the post-war period have been based on the findings and recommendations of these panels.

India's future course of action

The spectacular progress made by other countries need not overawe us and in an attempt to bridge the wide gulf, we should not start simply copying the measures adopted by them without reference to the conditions available in our country. One such instance is the employment of automatic machines in the glass industry which has often been recommended. These machines are no doubt good and helpful but viewed in the context of our present low consumption of individual items, their indiscreet use may lead to difficulties. In the U.K., U.S.A. and other European countries, the apprehensions that were at one time felt about their creating unemployment have not been justified. This is one of the aspects in which the Indian Ceramic Society by an objective analysis of our circumstances can help to give guidance to the industries and also educate the public in general.

As I said last year, our immediate problem is to produce quality articles at low cost so as to bring them within easy reach of the common man. The higher cost of raw materials and the low efficiency of production are not the only two factors contributing to the high cost of production in India. A fairly substantial portion is due to the high percentage of rejects. These losses can be avoided if the raw materials are judiciously selected and processed, the furnaces are properly built and operated under necessary controls and so also the various other operations performed either manually or carried out with the help of machines. What can be achieved by a proper control of the operations is now fairly well established and need not be repeated here. I feel pretty confident that not only the cost of production can thus be appreciably reduced but even the quality of the articles will have a noticeable improvement and the occasions for appeal to the patriotic sentiments of the consumer to buy country-made goods and to the Government for assistance will be considerably few. We should now realise that if we are to face the situation as it is developing in the world, we must have to seek protection in the quality of our production for which adequate technical control of the different operations has to be introduced. This will need employment of technically trained persons at the works as also some basic equipment. Naturally, this will mean a little additional cost but it will certainly repay itself many more times. In recent years, I have been associated with such enquiries from the industry and I have no hesitation in saying that a little supervision and intelligent check at proper stages can save a lot of money and add to the prestige of the producing firms regarding quality of their products. One difficulty that has very often been felt in tackling any such enquiries is the absence of data and even when some technical personnel are working, the data are either not readily available or are meagre. The importance of proper data cannot be over emphasised as they form the very basis of analysis of the trouble and are of immense help in finding solutions to the problems. It may be that on many occasions the supervisory staff of the factory may themselves by simply looking at the previous data find solutions to their difficulties. Further, it is on the experience of such information that the backbone of successful operation can be built up. It is gratifying to see that some of the factories have already started employing technical personnel but the move should not be more general. The Ceramic Society can be of assistance by writing short notes and informative articles in emphasising the importance of control by comparative examples and even giving information on the methods of control.

There have occasionally been complaints from the industry that the technical men were not quite up to the mark. In this address it will not be desirable to examine the merits of this question and instead of just giving explanations it would be best if the leaders of the industry and members of the Society would go into a committee and formulate proposals for the present requirements. I am sure the University authorities who are anxious to make their alumni useful to the industry would be very glad to give consideration to such proposals while framing courses of study for such subjects. One of the drawbacks from which our technological teaching institutions are suffering is the lack of proper equipment. For providing facilities for technological training in these subjects, the Banaras Hindu University took the lead but with limited funds it could not obviously spend more money on equipping these departments. I understand that the Government are also considering to supplement these facilities by suitable funds. But as this training is primarily in the interest of the glass and ceramic industries, would it be too much to expect these industries producing goods worth at least rupees 10 crores every year to raise a sum of about rupees two lakhs annually which is not even 1/100th of the total production for ensuring training of technicians who will play an important part in their future progress.

In modern age, the wealth of a country depends to a very large measure on the extent to which the resources of that country are developed. America, the land

of plenty today, was not so about thirty years ago when her resources had not been developed. It is, therefore, not just enough to possess resources—what is more important is that they should be developed for raising the standard of living of the masses. In this development, science is bound to play a very prominent part and the Indian Ceramic Society representing a fairly wide cross-section of interest, the manufacturers, scientists, technologists, students, etc., should take upon itself the task of enlightening the public and the Government about the need of these developments. This may possibly need some orientation in the policy of our journal which can be the only medium of this service. I personally feel that in our present position, mere insistence on publication of results of original work, though certainly a necessary feature for a technical journal, will deprive us of a still greater service expected of the Society. I might touch here a little on the occasional discussion that we now hear about fundamental research and applied research. Whereas the basic research has advanced from the individual's desire to know more about nature, the industrial research has progressed from a desire to make the world better for himself. Fundamental research is essential for the progress of applied research and must be pursued vigorously, but judging from the needs of the country and the great lee-way it has to make to catch up progress with other advanced countries greater emphasis than placed hitherto is necessary on industrial research. There is a good deal of fundamental knowledge available which has still to be applied for the promotion and progress of our industries.

The average person does not seem to be appreciative of the position and importance of glass and ceramic industries. It is not realised that the indispensability of some of the products of these industries, such as refractories for the production of steel, key of key materials, insulators for the electrical appliances and transmission of power, optical glass for scientific and defence instruments and laboratory glassware and porcelain articles as essential equipment for technical colleges and research institutions, places them amongst *key industries*.

I, therefore, visualise that in future the Indian Ceramic Society should take upon itself the task of providing a sort of "brain trust" for educating and guiding the public not only in matters of immediate interest but also in the future planning of development of our resources. Our Society has not reached a good position and with the expansion of the industries and establishment of research institutions time has now come to reorganise its activities into more fruitful and serviceable channels. On the occasion of this Silver Jubilee I appeal to the members of the Society to feel conscious that they serve industries which occupy a key position and their responsibility is very great. With determination, devotion and faith in the spirit of science, I am sure, we shall succeed in discharging the responsibility placed on us.

FIRST ELECTRIC TUNNEL KILN IN E. AFRICA
(*Continued from page* 172.)

normally the mid-day atmospheric conditions at Jinja are favourable to the efficient drying of clay, the humidity rises considerably at night and tends to crack products which have reached the last stages of drying. A recuperator type heat exchanger, preheating tunnel, and batch drying chambers were, therefore, designed and erected by the Uganda Public Works Department in addition to the tunnel kiln. The recuperator was included so that the flow of air in the tunnel kiln could be reduced to the minimum required for efficient firing, thus reducing the amount of heat taken away by the exhaust air.

A trial test, without the recuperator, using the minimum quantity of air necessary for the efficient firing of the ware in the kiln, showed that exhaust air taken straight from the kiln into the preheating tunnel contained excessive moisture. This condensed on the products in the lower, cooler parts of the preheating tunnel and cracked the clay, causing stacks to collapse later when they were passing through the kiln. The wet air from the kiln is used, therefore, in the recuperator to heat fresh air which is blown into the preheating tunnel and from there into the batch drying chambers where it passes into the atmosphere before reaching its saturation temperature.

Automatic feed to Grinders and Pulverisers

Three grinders or pulverisers fitted with Simon "Velofeeders" and Automatic Electronic Controllers will, it is claimed, do the work of four grinders not equipped with positive automatic control of this kind. The controllers ensure that the feeders load the grinders steadily, reducing maintenance to one-third of that required in manually set grinders. There is a saving in labour, since little supervision is required. Power drive efficiency is increased by up to 5 per cent. as the driving motor works at full load instead of a usual 66 per cent. of load.

Many industries use pulverising or grinding equipment to reduce material to a required size, but although they employ up-to-date automatic control methods for other processes, grinders and pulverisers are frequently adjusted by hand. When a grinder or pulveriser chokes due to overfeeding, it must be stopped, opened up and the choking material removed. In trying to avoid this, operators run machines at only 60/70 per cent. of full capacity as a precautionary measure, thus eliminating stoppages but at the same time cutting output.

To encourage attendants to load machines more economically, some firms fit controls which stop the feed to the grinder when the driving motor is overloaded. Such devices are successful if a machine is used for only one material and the feeder set manually to its correct position at the outset. But where a machine handles different materials the feeder must be set by hand to suit the densest material. When there is a change-over to lighter material, underfeeding occurs. It is obvious, therefore, that a positive system of feed control is required to eliminate variations in feed rates. The Simon "Velofeeder" complete with Auto-

Three grinders with Velofeeder control unit at the compound mill of J. Bibby and Sons Ltd., Liverpool

matic Electronic Controller which, it is said, maintains full feed and not the usual 60/70 per cent. of feed is an answer to this; hence the claim that three positively controlled machines will do the work of four uncontrolled machines. The Velofeeder is a mechanical vibratory feeder, and the amplitude of vibrations can be varied to adjust the rate of feed through a very wide range. It has a small, geared reversing motor, which alters the feed rate adjustment mechanism in either direction as signalled by the Automatic Controller.

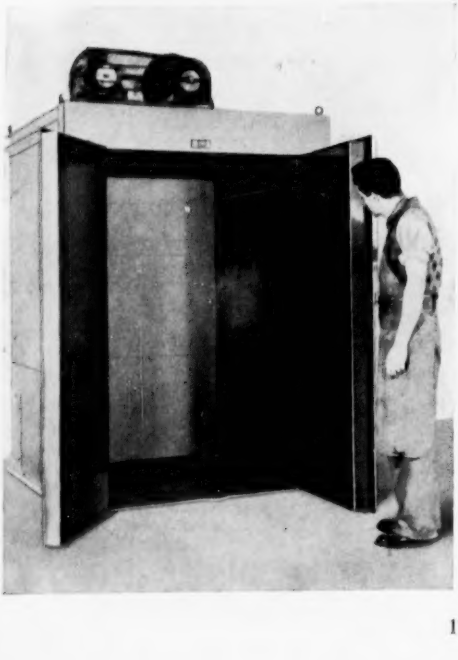
The controller receives current directly proportional to that taken by the motor driving the grinder or pulveriser; if this current falls below the full-load current of the motor, the controller regulates the small geared motor gradually and the rate of feed to the machine is increased. If the current exceeds the full-load current of the motor the feed rate is gradually reduced. Usually, the controller is so arranged that there is a dead spot covering plus and minus 2½ per cent. of full-load; inside these limits no correction takes place. It is found that this eliminates hunting.

The efficiency of the driving motor is illustrated by this example: a manufacturer has four 100 h.p. grinders, each running at 75 h.p. at an efficiency of 82 per cent. The total kW input to these motors is therefore 272. If three grinders operate at full load they use a total of 300 h.p. at 87 per cent. efficiency, for which the total kw input is 257. This gives a saving of 15 kw, which, at 1d. per unit, amounts to 1s. 3d. per hour, or the equivalent of £375 on continuous 24 hour duty over a period of a year. The increase in power factor of the motor also offers an economy to those whose electrical tariffs are based on a maximum K.V.A. demand, reducing the electricity debit.

Both the Velofeeder and the Automatic Controller are of extremely robust construction, designed for continuous 24 hour service in dusty atmospheres; it has been shown in practice that they can be relied on to give satisfactory, trouble-free service.

The Velofeeder and Automatic Controller will solve a problem which has created a bottleneck in the grinding and pulverising field for a number of years. Results so far obtained indicate that leading manufacturers are adopting the unit as the answer to feed troubles of this kind.

AN OVEN AT FLOOR LEVEL



A new electric oven made to stand on a heat-insulated floor for charging at floor level has been designed by **The General Electric Co. Ltd.** The design greatly facilitates the use of bogies which can be moved directly into the oven. By using two or more bogies the oven can be kept in continuous operation.

To minimise heat losses through the walls the oven has a double-cased construction, the space between inner and outer casing being packed with a high grade refractory. Tubular heating elements are arranged in the oven walls behind baffles. A fan in the roof provides vertical forced air circulation down over the elements and up through the oven. This increases the rate of heat transfer to the charge and the overall efficiency, the forced air flow evening out the temperature distribution and reducing temperature gradients in the oven to a minimum.

The oven can be supplied in a wide range of sizes to operate at temperatures up to 250° C. An oven with internal dimensions of 5 ft. 8 in. high by 3 ft. by 3 ft. will probably have a rating of about 16 kW, the exact loading depending upon the nature of the charge and the permissible heating time.

Electrical Hazards in Ceramic and Glass Industries

by Dr. W. SCHWEISHEIMER
(New York, U.S.A.)

Prevention and Precaution

ONE of the first safety rules against electrical hazards is that all electrical equipment and extension cords should be grounded and only approved wiring and equipment should be used. This warning was sharply illustrated by an accident which occurred recently in a factory where safety glass is manufactured. One of the men on a hot day came into contact with a wire through which he sustained an electric shock. He had had such electric shocks before. They never did him any harm. That day, however, "lightning struck him." Immediately after the shock he felt ill, he vomited and went to a nearby house. He complained of severe headache and suffered from a convulsive seizure. He was admitted to the hospital with a temperature of 102° F. He could hardly breathe and died approximately 12 hours after admission to the hospital.

A Wet Body a Good Conductor

Accidents due to electricity are more dangerous on hot days when people are perspiring. The wet human body is a better conductor than dry skin. We know how dangerous it is to stay on the beach or in the water when there is a threat of a thunderstorm. The wet body is likely to be a lightning "magnet." Damage from electric shock usually is either of a temporary nature, or it is fatal. Rarely a permanent damage will remain after electric shock. Low voltages are dangerous since they interfere with the mechanism of the heart muscle. They produce what we call ventricular fibrillation, a disturbance in the muscular activity of the heart ventricle. High voltages, on the other hand, produce damage through the nervous centres. The heart stops beating, the lungs stop breathing.

Low-Voltage Hazard

No man in the ceramic or glass industries would approach a high-voltage wire. However, there is every need to be careful of low voltages. Most industrial electrical hazards are in the lower voltage range, 120-144 volts. Low-voltage current is hazardous particularly when the body contacting it is in a good condition for passage of the current, e.g., when the skin is wetted by perspiration, by a bath, by steam or a drenching rain. Under thoroughly wet conditions, the resistance of the skin may fall to as low as 1/100th of its dry value.

Workers in the ceramic and glass industries are exposed to many low-voltage hazards such as defective portable lights; defective electric cords which render metal objects alive; open switchboards and fuse boxes which were used in older installations and expose to low-voltage shock and flash burn; improper fusing; defectively-built electrical equipment, etc. Most contacts with high voltages result in serious injury. In the range from 1,000-7,500 volts almost every contact will cause a non-breathing shock condition. Half of them can be revived if artificial respiration is promptly started. Circuits of more than 7,500 volts are a hazard even without contact since the electric current is able to jump a gap in this volt range. Recently, high-voltage accidents have been described where men came in contact with conductors carrying 45,000-50,000 volts. Artificial respiration had to be carried out for a long time, and some of the men got well again.

Precautions against Electric Shock

Possibilities of precaution against electric shock have been described frequently. Never touch a swinging wire, it may be crossed with a "live" wire somewhere along the line. If you are working near a wire which dangles loosely, snub it in a safe place with rope until ready to connect it. Don't use electrical equipment that has the insulation broken or that is "shorted." It is dangerous to rescue a victim from contact with a live wire unless you are well trained in electrical matters. Turn off the current, but don't spend valuable time in looking for the switch. Have someone phone the power company to shut off the current. Use a long dry stick, board, dry rope, clothing, rubber stick, etc., to remove the wire from the man or the man from the

wire. Stand on a dry board, or other dry material, or use rubber boots. Never use your hands without protection. Even rubber gloves may not be safe. Electrical workers for live work use "hot-line tools" which are mounted on long handles made of insulating material. Most work can be done with them at a safe distance from the hot line.

For first-aid after electric shock start artificial respiration immediately. Sometimes it will be necessary to use artificial respiration as long as 3 or 4 hours before success can be seen. The doctor uses injections of heart stimulants in such cases. Recently, the operator of a machine in a ceramic factory, after an electric shock, was unconscious for 40 min. During the whole time artificial respiration was carried out. He received injections of coramine, a heart-stimulating drug. He had to stay in bed for a few days, but recovered without any lasting damage.

Electric Burns

More severe burns are said to be caused by alternating current than by direct current. But Dr. Hart Ellis Fisher, after twenty years' experience with over 1,000 cases of electric burns, does not believe in a difference depending on the type of electric current. It is true that direct currents contain a much lower voltage, but burns seem just as serious from low voltage as from high voltage. Next to bone, the skin is most resistant to electrical current. That is why burns are almost always present in electrical accidents. Some of the skin lesions appear punctuated or resemble a bullet wound. Others are round or long.

Burns may occur on any part of the body that comes in contact with an electrical conductor. Most electric burns are incurred industrially. If a shock has been combined with the burn, keep the patient warm (not hot), give him sweet drinks and reassure him of quick recovery. Experts recommend that for first measure, while the wound is still dry, the burn should be covered with a well-chosen ointment and light bandages of gauze. Infection of the wound is prevented or kept to a minimum by intelligent first-aid methods which avoid any uncleanliness. Do not touch the burn nor the gauze which will cover the burn. Burns usually are classified in three degrees. A first degree burn may cover a large area of reddened and unbroken skin. A second degree burn is similar to a condition due to a scald. The skin is blistered and broken. In a third degree burn the tissue is burned away to a certain depth. In cases of electric burns the intake of water, tea, coffee and other fluids and salt solutions will be helpful.

American Technical Digest

Copies of the original articles to which these summaries relate can usually be obtained from the Science Museum Library or from the American Library, American Embassy, 1 Grosvenor Square, London, S.W.1.

Improved Permeameter

The results of a study of the permeability to air of various fire bricks, and of refractory clay pots used for melting glass, may be used as a means of improving the uniformity and quality of production.

A permeameter of improved design (See Fig. 1) used by the National Bureau of Standards provided an easy and accurate means of determining the relation between the pressure gradient across two opposite faces of a test specimen and the rate of air flow through the specimen. Bulk densities, moduli of elasticity, and porosities were determined in addition to flatwise, edgewise, and endwise permeabilities.

Definition of Terms. — Permeability is expressed in terms of the flow of air in cu. cm. per sec. that will pass through two opposite faces of a 1 cm. cube, when the pressure between the two faces differs by 1 gm. per sq. cm. Information on the significance of permeability of refractory materials has been rather limited, but its possible importance has not been overlooked. For instance, highly permeable refractory bricks have been selected for the construction of furnaces of improved efficiency.

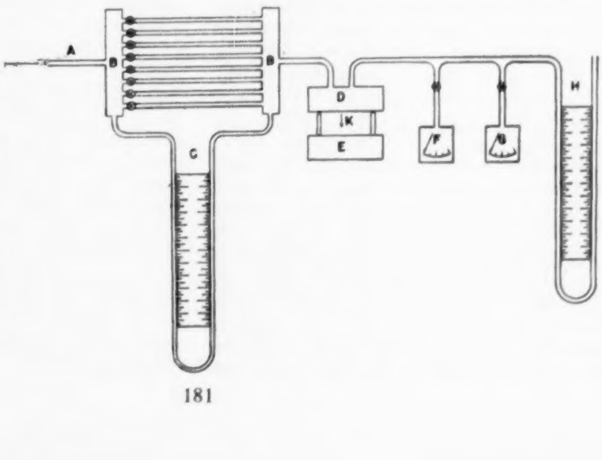
Permeability is believed to be important in determining the resistance of refractories to molten glass, alkali vapour, carbon monoxide, and molten slag, and also in determining heat losses due to flow of hot gases through the walls of refractory installations. The study was undertaken primarily to obtain more definite information about room-temperature permeability of firebricks manufactured in the United States.

Making the Test. A specimen to be tested is placed in a "seal box" arranged to permit air under pressure to be applied to one face so that it flows through the brick and out into the room at the opposite face; the other four faces are sealed with a soft rubber inner tube inflated with sufficient pressure to prevent air from escaping. The rate of air flow through the brick and the pressure difference between the two non-sealed faces are measured, and from these data the permeability is calculated.

To measure flatwise, edgewise, and endwise permeabilities of firebrick, three seal boxes were required. In each case, air under pressure enters the top of the box through one of the two fittings, passes through the brick from upper horizontal face to lower horizontal face, and flows out into the room through the open bottom of the box. Through a fitting on the side of each box, compressed air is supplied to the rubber inner tube arrangement that fits over the vertical faces of the brick: this tightly seals the vertical sides of the brick so that no air can flow through them. The second fitting on the top of each box is for connecting pressure gauges to measure the difference in pressure between the top and bottom surfaces of the brick.

The air supply is furnished by a compressor. After passing through a trap and filter, three pressure regulators, and two drying towers, the air enters a flow meter. This device consists of one or

Fig. 1. Diagram of the improved permeameter for measuring permeability. Key: A. Inlet for regulated dry air. B. Bank of capillaries. C. Flow manometer. D. Seal box for specimen. E. Support for seal box and specimen. F. Dial bell pressure gauge, 0 to 2.5 g./cm.^{2} G. Dial bell pressure gauge, 0 to 10 g./cm.^{2} H. Pressure manometer, 0 to 40 g./cm.^{2} K. Outlet for air



more capillary tubes connected across a kerosene manometer; with proper calibration, the pressure difference between the ends of the capilaries, as indicated by the manometer, gives the rate of flow. From the flow meter the air enters the top of the seal box containing the test brick. Pressure difference between the top and bottom surfaces of the brick is indicated by two low-range pressure gauges and a higher-range manometer, all connected to the top of the seal box. Flow rates per unit pressure drop across specimens have been accurately determined for a range from 0·00114 to 542 units with this improved permeameter.

Results of the Test. Permeabilities were determined for some eleven types of firebricks: insulating, super-duty fireclay, high-duty fireclay, mullite, acid-proof silica, magnesite, chrome-magnesite, magnesite-chrome, kaolin, and 60 per cent. alumina. Permeability was generally lower flatwise than edgewise or endwise—probably because most of the firebricks were made by the dry press process. Correlation between permeability and the other determined properties was low, but there was some tendency for higher permeability to be associated with higher porosity and with lower bulk density and modulus of elasticity. Specimens of some unburned bricks with organic binders were measured both before and after heat treatment; their permeability was greatly increased by 1,600° C. heat treatment. Permeability was much more sensitive to heat treatment than were porosity, bulk density, and modulus of elasticity.

Better Criteria. Similar measurements were made on specimens cut from slip-cast refractory-clay pots of the type used for making optical glass. Permeability was found to be a better criterion for resistance to attack by molten glass than was modulus of elasticity, porosity, or bulk density.

(*Brick and Clay Record,* October, 1953, p. 39.)

A New Photocell.—A contribution to the numerous applications of infra-red radiations in science and industry is made by a new photocell recently introduced by the Communications and Industrial Valve Department of Mullard Ltd., Century House, Shaftesbury Avenue, London, W.C.2. This cell, the 61SV, is of the photoconductive lead sulphide type, and is characterised by extreme sensitivity to infra-red radiations and a high speed of response. It has the additional advantages of a high signal-to-noise ratio, small size and robustness. Among the applications listed by the manufacturers is the monitoring of gas, oil-fired and pulverised fuel furnaces.

GRAVITY FLOW PROBLEMS

GRAVITY flow handling of powders involves a wide variety of familiar problems which increase as the angle of decline is decreased, to the point where movement is virtually impossible. A solution to this problem is now being successfully developed in the use of porous filter troughing through which air is circulated at a relatively low level of pressure. The effect of this circulation is surprisingly efficient, the air forming a cushion on which the powder rests. The angle of drop can be very slight in such instances, but with the assistance of the compressed circulated air extruding through the filter troughing, movement is assured and rapid. Using this method of powder fluidisation, fine powdered materials which would normally lie dead on a gravity chute can be moved easily and speedily, along the same level, eliminating the present need to elevate sections of equipment to provide the necessary vertical, or nearly-vertical gravity drop. **Aerox Ltd.** of Hillington Industries Estate, Glasgow, who specialise in the manufacture of industrial porous ceramics, have done a considerable amount of work in this new field and contemplate the expansion of that work to cover hopper and pneumatic conveyor assembly as well as the filter slabs which have been their main interest to date.

They believe that a very considerable field of development is offered in all the industries handling fine powders; the food, milling cement and fertiliser industries are obvious fields for applications of this powder fluidisation technique, whereby solid powders with all the inherent reluctance to continuity of flow can be persuaded to flow steadily and economically on an air cushion. Experience to date is extremely satisfactory and has justified the company in planning a further expansion of this work, which links up with their major interest in the production of ceramic filter materials.

The British Ceramic Society

We give below abstracts of the three papers appearing in the Transactions of the British Ceramic Society for May, 1954.

Bricks made with Pulverised Fuel Ash, by B. Butterworth.—British power stations are producing a great and growing tonnage of pulverised fuel ash, which is costly and troublesome to dispose of. Brick-making is one of the very few ways in which this ash might be converted into something useful. The manufacture of bricks from p.f. ash is therefore being studied by the Building Research Station in co-operation with British Electricity Authority, and the present paper is an interim report both on work forming part of this investigation and also, briefly, on parallel developments that have come under the author's notice.

First the nature of p.f. ash is described. Work on the addition of moderate amounts of ash to clay bricks is next reported, and it is shown that clays vary widely in their ability to carry the ash without reduction in quality. Sticky clays, deficient in non-plastic material, benefit most from the addition of p.f. ash. Finally, attempts to make bricks consisting mainly of p.f. ash are described. Satisfactory bricks have been made with 85 per cent. of ash and 15 per cent. of a plastic clay to act as a bond. Bricks made by plastic processes are better than semi-dry-pressed bricks from similar mixes, although more liable to scumming, unless sand-faced.

Full-scale Experiments on the Addition of Pulverised Fuel Ash in Brickmaking, by A. J. C. Watts.—Details are given of the effects of adding pulverised fuel (p.f.) ash, obtained from electric power stations, to certain Weald clays in the production of wire-cut sand-faced facing-bricks.

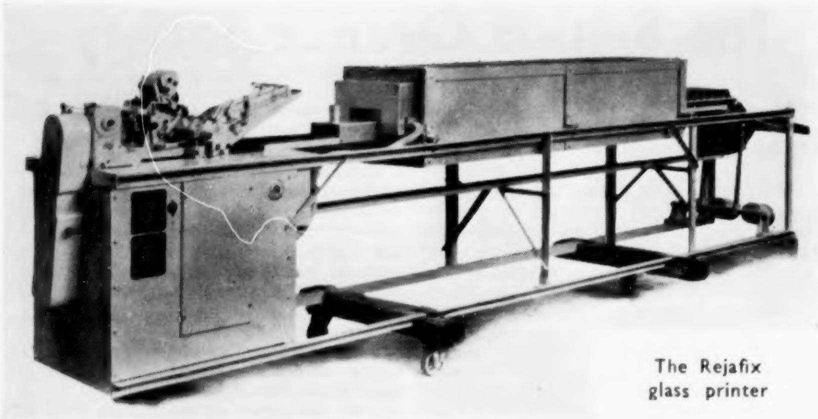
The Thermal Expansion Properties of Compositions containing Lithia, Alumina and Silica, by R. P. White and G. R. Rigby.—A series of mixes has been examined in which the composition was varied from the $Li_2O.Al_2O_3.2SiO_2$ to the $Li_2O.Al_2O_3.8SiO_2$ formula. All these compositions, after being fired to 1,200° C., possess a low thermal expansion but have the disadvantage that the refractoriness is also low. The effect of adding up to six parts of lithium oxide per 100 parts of clay and grog has also been examined. Amounts greater than two parts per 100 produce a serious reduction in the refractoriness whereas less than two parts per 100 is ineffective in reducing the thermal expansion. A mix containing fifty parts of fireclay grog and two parts of lithium oxide has a reversible thermal expansion of 0·390 per cent. between 20° C. and 1,000° C. and a refractoriness of cone 15 (1,435° C.)

Aerox Ltd.—Aerox Ltd., of Hillington Estate, Glasgow, are to develop a new range of sterilising water filters based on their successful completion of filters of this type to the order of a leading pharmaceutical company. The problem presented was the manufacture of a completely sterile filter for antibiotic purposes. After exhaustive search on the Continent and in the U.S. for a suitable sterile filter, the client presented Aerox with the most satisfactory material and asked for a similar or better filter. The result was a completely sterile ceramic filter which has been used with success in the highly critical field of antibiotic production. Success in that field has now encouraged its production to the field of water filtration with particular reference to areas where local conditions make special care necessary.

Its application is expected to be for use in tropical conditions aboard ships, in hotels, and in public buildings, or in any position where completely safe water supply is demanded.

Muir-Hill Handling Equipment.—F. Boydell and Co. Ltd., manufacturers of the Muir-Hill range of materials handling equipment, at the Mechanical Handling Exhibition held at Olympia, London, from 9th-19th June displayed specimens of the well-known Muir-Hill S.S. Mechanical Loader, the Muir-Hill Shunter and, of especial interest, the LH-1 Hydraulic Loader specially designed for working in small, confined spaces.

"Field Engineering Radiographic Unit."—The Power-Gas Corporation Ltd., Parkfield Works, Stockton-on-Tees, have published a leaflet (RU454) which gives details of a self-contained radiographic unit with fully-qualified staff which is available for hire and able to travel to any site for the examination of welded vessels, pipework, structures, etc., in the field. Within a short time of the radiographic examination being completed the film can be processed in the unit's darkroom, dried and examined.



The Rejafix glass printer

INKS FOR HIGH-SPEED MARKING

THE production of an ink which when fired into glass or pottery cannot be rubbed off or defaced, and of a high-speed printing and marking machine which tackles articles or any shape or irregularity of surface, opens up wide possibilities of economy in the ceramics field.

During the war there arose the problem of printing on cylindrical surfaces, and a solution was found by Rejafix Ltd., who developed a machine capable of handling very large quantities of shell cases.

From that simple, hand-operated machine, a high-speed, power-driven, fully automatic machine capable of handling upwards of 5,000 articles an hour irrespective of material or variation of shape has been developed.

Side by side with the development of this machine, the Rejafix laboratories have developed specialised inks so that the high-speed process copes with indelible marking on metal, plastics, glass, porcelain, cardboard and wood. Of particular interest is their new process for firing inks of any colour indelibly into glass or pottery. The process consists of a conventional muffle furnace into which bottles are rolled after printing. The inks are of a special character, demanding the highly exacting temperature control for which the machines are designed. Thus, markings are fused firmly into the surface and remain as permanent as the glass or pottery itself. Some idea of the efficiency of this system can be gained from the fact that the Rejafix system of marking is now officially accepted by the pharmaceutical profession because fused-in ceramic inks mean that there is never any possibility of anæsthetic or other ampoules losing their identity under the most stringent sterilisation processes. After the initial outlay on machinery and installation, running costs are light.

Turner and Brown Ltd.—We have received from Turner and Brown Ltd., Bolton, details of their new design of exhaust equipment for use with chemical plant. The new equipment which consists of "Turbro" centrifugal fans and a new form of ducting is constructed almost entirely from a recently-developed grade of rigid plastic industrial sheet (Vybak VR215) based on polyvinyl chloride (PVC) and supplied by Bakelite Ltd. The material has high impact and tensile strength, good dimensional stability and great resistance to chemical attack or weathering.

Elliott Brothers (London) Ltd.—A new high-speed digital computer—the 402—embodying many new features has just been produced by Elliott Brothers. The Elliott 402 has fifteen immediate access nickel line registers and a magnetic store holding 94,000 bits. Monitoring and test equipment together with marginal testing facilities are incorporated in the machine itself. Its high speed is attained with only 550 valves and it consequently has a low power consumption.

Further Ceramic Abstracts

The following abstracts have been made from unpublished reports by the Technical Information and Documents Unit of the Department of Scientific and Industrial Research.

The Measurement of Thermal Conductivity of Refractory Materials

In Part I it is shown that the thermal conductivity of a porous material is due to both conduction and radiation processes. A theory is presented relating the effective conductivity to the conductivity of the solid material, the emissivity of the surface of the pores to their size, shape and distribution. Materials can be prepared having different thermal conductivity in different directions. In Part II, a study of isometric spherical and anisometric cylindrical pores in alumina, graphite and nickel shows that pore orientation is found to affect profoundly thermal conductivity for a given porosity. At temperatures above 500° C. pore size and emissivity become important. In Part III measured thermal conductivity values for several ceramics are given and calculated data, based on theoretical studies, for fifteen pure oxides. Tables and plots for thermal conductivity from 100° C. to 1,800° C. are included. The variation of conductivity between polycrystalline oxide materials decreases from a factor of more than 100:1 at room temperature to about 10:1 above 1,000° C.

Atomic Energy Commission, U.S. Report NYO-3647 and Massachusetts Institute of Technology, September, 1953. 61 pp. P. H. Norton, W. D. Kingery, A. L. Loeb, J. Francl, R. L. Coble, T. Vasilos.

Further Ball Milling Studies on Pure Oxides

The effect of milling time, type of mill and lubricant used on the compressive strengths of pure oxides and magnesia bodies are described. Strength data for various milled samples of pure alumina and mixed alumina-spinel aggregates and the effect of compacting pressures is presented graphically.

Illinois University. Department of Ceramic Engineering. October, 1949. 12 pp. D. G. Bennett, L. R. McCreight. PB107261.

Mechanism of Cermet Oxidation at High Temperatures

Among the factors which determine the usefulness of metal-ceramic mixtures for high temperature high stress applications, is their resistance to oxidation in air at high temperatures. Experimental procedure and results are given for a study of the mechanism of cermet oxidation including observations on the rate of penetration of the oxide layer, and the weight gain as a function of time during exposure to air at temperature from 600° C. to 1,000° C.

Alfred University, New York. Technical Report, October, 1950. 13 pp. W. B. Crandall, H. S. Levine, G. E. Lorey, V. D. Frechette.

FUTURE OF B.I.F.

An appeal to British industry to support the British Industries Fair was made (on Friday, 14th May) by Mr. Kenneth Horne, a director of the company formed last month to promote the fair.

In a broadcast, Mr. Horne, one of the seven business men appointed to run future fairs, said that they would in future be conducted with greater freedom and industry would have a sense of partnership in the fair and therefore a greater interest in making it a success.

Speaking of plans for the future, Mr. Horne, who is sales director of the Triplex Safety Glass Co. Ltd., said that five decisions have already been made. The directors were planning to spend up to £100,000 yearly on home and oversea publicity for Britain's great "shop window." Individual directors intended to visit personally other international fairs in search of new ideas and suggestions. Aggressive steps would be taken to attract more home and oversea visitors. Suggestions from trade organisations in this country would be welcomed and contacts would be renewed with oversea customers. Finally, they would examine all those ideas for the improvement of the fair which, in the past, the Government, which had had to be impartial even in show business, could not exploit. "Those five points are a very humble start towards trying to build up a bigger, better and brighter British Industries Fair," said Mr. Horne. "We are determined to make the B.I.F. increasingly valuable to British industry."

Mr. Horne said that the 1955 fair would be held in London and Birmingham from 2nd to 13th May.

SCOTTISH RAW MATERIALS

Scope for increased use of native Scottish minerals is indicated by the Scottish Council (Development and Industry). Speaking at a conference in Edinburgh on 14th June. Mr. W. S. Robertson, technical secretary of the Council said that there was every prospect of an expanded use in the near future. Extensive dolomite deposits, talc and serpentine are the materials mainly involved and are the subject of a detailed report which the council has now issued. Mr. Robertson admitted the problems of exploitation but added the belief that much of the neglect arose rather from lack of knowledge than from actual lack of materials. With a continuing development of such local mineral resources, and of forestry, and manufacturing, the future prosperity of many local areas seemed reasonably secure. The slow trend to increased usage would, he believed, be speeded up as a result of the improved information available in the reports.

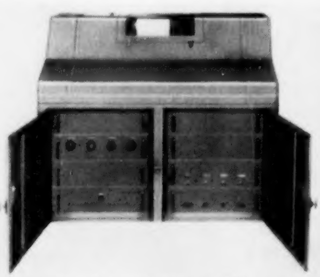
Mr. J. A. D. Nimmo, a member of the staff involved on the work and secretary of the Dolomite Group of the Panel believed that the exploitation of the minerals might be regarded as marginal economic propositions. The minerals, except for talc, occurred in large deposits which made winning relatively easy. Transport costs might be two to three times mining costs if the material had to be taken to a manufacturing centre in the south, as a raw material.

Transport on one mineral from Scotland to the Sheffield area was quoted at £3 per ton. But even that fact did not prevent some development, as in Shetland where talc and serpentine are, in fact, being produced. Output in each case is approximately 4,000 tons a year and was increasing. Possibilities of dolomite exploitation are regarded perhaps more favourably than in the case of other minerals. Industry can accept dolomite in volume as has been demonstrated in the recent development of the Stirling "Rocksil" factory. The possibility of a magnesium industry has also been mooted although the prospects here are regarded with caution since other areas are perhaps as well placed to undertake this work. One proposal is that dolomite should be used as a source of agricultural lime. It is proposed here to set up a plant in Ross-shire to undertake this practical work.

The three reports which have been produced are "Dolomite in Scotland," "Talc in Scotland," and "Serpentine and Olivene Rock in Scotland."

The importance of these reports derives perhaps more from recent industrial developments than from the reports themselves. These several projects now in production are based on native Scottish raw materials and are evidence that the minerals can be worked to advantage—although obviously more so if the manufacturing location is within the raw material area and not at a distance, with all the limitations of high transport costs on the bulk raw material.

Salford Electrical Instruments Ltd.—A publication describing the operation of the S.E.I. electro-magnetic transducer system has recently been issued by Salford Electrical Instruments Ltd. The system, which enables a reading to be taken at a distance of up to 1,000 yards from the point at which the actual measurement is made, is highly versatile. It is used in the aircraft industry, in asbestos sheet manufacture, in plastics production, in rolling mills and in coal bunkers, as well as for many other applications. The new publication includes a general description, describes the standard heads and indicating instruments used with this system, and shows six typical applications in diagrammatic form; a full technical specification is also included.



An example of an electronically controlled automatic weighing machine manufactured and marketed by the British Tabulating Machine Co. Ltd., 17 Park Lane, London, W.1, from whom further information can be obtained

REVIEWS

Indian Ceramics. Vol. I. No. I. April, 1954.

A monthly journal devoted to pottery, refractories, glass, enamelling and cement industries has just been produced, and is published at 17 Sourin Roy Road, Calcutta 34, by some of the leading Indian experts in this field. As Professor Ernst A. Hauser of Massachusetts Institute of Technology says in his foreword, "long before other countries ever paid any real attention to ceramics, India was already famous for its contribution." For this reason it is an important event that India should revive its ceramic journal, publication of which was stopped fourteen years ago. Much of the magazine is given to an article by S. K. Chatterjee of the Bengal Ceramic Institute, Calcutta which reviews the subject very fully. It is a pity, however, that the text of the magazine is so full of typographical errors. The journal is in English throughout. We would wish our Indian counterpart every success.

Proceedings of the International Commission on Glass. Vol. I. June, 1954. Butterworths Scientific Publications. 25s.

The first volume of an annual publication devoted to glass and sponsored by the International Commission on Glass has just been published by Butterworths. The general aims of the Proceedings are outlined in the introduction where also the contents, which will be particularly related to the work of the Commission, are divided into five main groups. These are:

1. Accounts of meetings of the Commission, summarised reports of its technical sessions, and announcements of relevant definitions, specification and standards which have been agreed internationally.
2. Reports and papers at the request of the Commission for presentation at its meetings.
3. Translations of a section of the most important papers published during each year in the journals of participating organisations.
4. Reviews of special fields of knowledge of glass technology made by recognised authorities.
5. Original papers offered directly for publication in the Proceedings.

The first issue of this new venture contains several well-illustrated articles and papers on glass processes and experiments by an international representation of experts. There is also a valuable world list of periodicals concerning glass, compiled by F. Newby, honorary librarian of the Society of Glass Technology, and another equally useful world list of current books on glass.

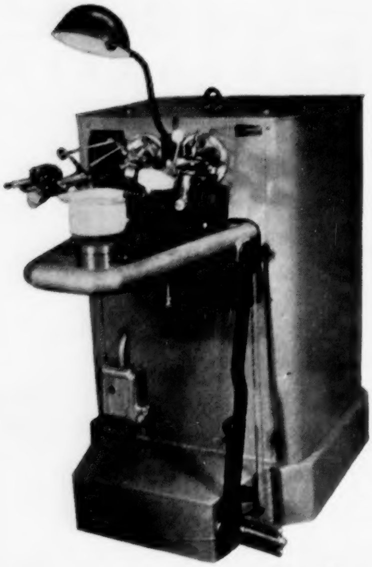
Pottery Quarterly. Vol. I. No. I. Spring, 1954. 3s.

We have received a copy of the new quarterly magazine, Pottery Quarterly, the aim of which is to provide a forum for those engaged in the specialised industry of pottery. The magazine is not purely technical and would seem to be so designed that it should appeal to a large readership. Mainly the emphasis appears to be on the studio potter, the amateur or the small professional, but the editors express the hope that the new publication will have articles of interest to retailers and industrial designers also. In this the first issue there are articles on the origins of the craft of pottery, raw materials for the studio potter, and several on the technical aspect of the craft. None however is written in such a way that the layman could not understand it. There is also a review of exhibitions and books.

The Art and Antique Restorers' Handbook, by George Savage. Rockcliffe Publishing Corporation. 15s.

Mr. George Savage, who by his scientific approach to the subject of the materials of the craftsman in his previous books "Ceramics for the Collector" and "18th Century English Porcelain" established a deserved reputation, has brought out a new book entitled "The Art and Antique Restorers' Handbook." The book is simply arranged in alphabetical form and covers a variety of subjects from abrasives to zebra-wood.

The problem of dealing with deterioration of art treasures in these days of overcrowded and understaffed museums is a very urgent one and there can be little doubt that for the small collector in particular this new book is of great value. The objects of art treated with the relevant chemicals and preservatives are to be found in their alphabetical sequence. There is a useful and comprehensive index.



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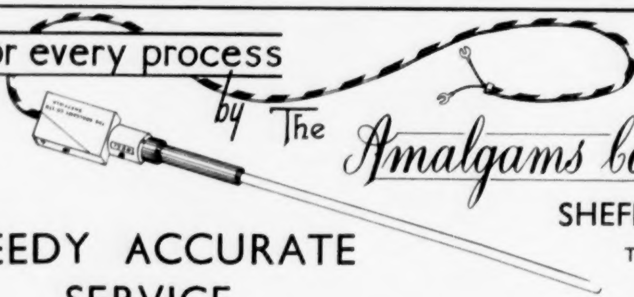

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MATERIALS FOR SALE

PORCELAIN GRINDING BALLS—1 ton each size 2½ in. and 3 in., surplus to requirements. Offers to FERGUSON EDWARDS LTD., Abbey Road, Barking.

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